

Title: Small Sided Games in soccer – A Systematic Review

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Hugo Sarmiento (Corresponding author)

Research Unit for Sport and Physical Activity (CIDAF), Faculty of Sport Sciences and Physical Education, University of Coimbra, Coimbra, Portugal

Postal address - Faculty of Sport Sciences and Physical Education, University of Coimbra, Santa Clara, 3040-256 Coimbra, Portugal; Phone: +351 914756015;

Email - hugo.sarmiento @uc.pt

Orcid: 0000-0001-8681-0642

Filipe Manuel Clemente

Instituto Politécnico de Viana do Castelo, Escola Superior de Desporto e Lazer, Melgaço, Portugal

Instituto de Telecomunicações, Delegação da Covilhã, Portugal

Postal address - Complexo Desportivo e Lazer Comendador Rui Solheiro – Monte de Prado, 4960-320, Melgaço.

Orcid: 0000-0001-9813-2842

Email – filipe.clemente5@gmail.com

Liam David Harper

University of Huddersfield

School of Human and Health Sciences

Queensgate, Huddersfield, HD1 3DH; Phone: +44 (0) 1484 471157; Email:

L.Harper@hud.ac.uk

Israel Teoldo da Costa

Universidade Federal de Viçosa – Campus Viçosa

Departamento de Educação Física

Núcleo de Pesquisa e Estudos em Futebol (NUPEF)

Av. PH Rolfs, S/N

Campus Universitário

CEP: 36570-000

Orcid: 0000-0001-9780-3456

Email: israel.teoldo@ufv.br

Adam Owen

BenficaLAB,

Sport Lisboa e Benfica Sport Science Department, Lisbon,

Portugal.

Centre de Recherche et d'Innovation sur le Sport,

Université Claude Bernard Lyon.1, Lyon,

France.

adamowen@outlook.com

António J. Figueiredo

*Research Unit for Sport and Physical Activity (CIDAF), Faculty of Sport Sciences
and Physical Education, University of Coimbra, Coimbra, Portugal*

*Postal address - Faculty of Sport Sciences and Physical Education, University of
Coimbra, Santa Clara, 3040-256 Coimbra, Portugal; Phone: +351 914756015;*

Email - afigueiredo@fcdef.uc.pt

Orcid: 0000-0001-6956-0514

Title: Small-Sided Games in Soccer – A Systematic Review

The purpose of this paper was to systematically review and organise the literature on soccer SSGs, in order to ascertain the most frequently researched topics, characterise the methodologies employed, and systematize the evolution of the related research areas.

A systematic review of Web of Science, Pubmed and SPORTDiscus databases was performed according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines. The following keywords were used: football and soccer, with each one associated with the terms: “small sided games”, SSG, “drill-based training”, “small sided”, “conditioned games” and “position games”.

The search returned 394 records. After screening against set criteria, a total of 77 manuscripts were fully reviewed. The most common topics of analysis were (1) pitch area; (2) player number: (a) with/without a goalkeeper; (b) with floater(s) in/outside the pitch; (3) goal: (a) goal vs scoring zone; (b) number of goals; (c) size of goals; (4) rules modification/task constraints (a) n° ball touches; (b) offside rule; (c) others; (4) training regimen, (5) coach encouragement.

This review provides valuable information on the complex relationship between technical, tactical and physiological interactions in SSGs and how the manipulation of these types of variables can improve the soccer training process.

Keywords: soccer, performance analysis, drill based games, conditioned games, training.

Introduction

Invasive team sports such as association football (soccer) are composed of stochastic interactions between teammates and opponents, resulting from a large pitch, the specific rules of the game, and the different player roles in the game (Aguiar, Botelho, Lago, Macas, & Sampaio, 2012; Silva, Vilar, Davids, Araujo, & Garganta, 2016). Soccer as a competitive sport at the professional level has evolved considerably in the last 20 years, mostly as a result of the increased frequency of attacking actions down the outer limits of the pitch (wings) (Barreira, 2013), and an increased speed of the game, as evidenced by an increase of 15 and 35% in ball speed and passing rate, respectively (Wallace & Norton, 2014). Furthermore, the high-intensity running distance and number of sprints (particularly short explosive sprints), along with the number of passes increased in the English Premier League from the 2006-07 season to the 2012-13 season (Barnes, Archer, Hogg, Bush, & Bradley, 2014).

Simultaneously, training methods have evolved from conditioning exercises without the ball that develop physical capacities (Bangsbo, 1994), to new methods and exercises which are able to simultaneously improve physical capacities along with technical and tactical skills, specific to the demands of modern soccer matches. Small-sided games (SSGs), also referred to as skill-based conditioning games (Gabbett, 2006), game-based training (Gabbett, Jenkins, & Abernethy, 2009) or small-sided and conditioned games (Davids, Araújo, Correia, & Vilar, 2013) are modified games played on smaller fields, with adapted rules and involving a number of players often lower than traditional soccer games (Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011). Small-sided games effectively integrate the specific

demands of soccer match-play and represent a useful solution to increase the efficiency of training.

Small-sided games allow the integrated training of the technical and tactical aspects fundamental to the development of young soccer players. The variability in movement during SSGs contributes to the development of a more generalized motor program to cope with a variety of similar but different situations (see Williams and Hodges, 2005, for a review). In addition, their structure and organization allow them to be used freely by any group of young people on any surface or space of play (e.g., street football), favoring the development of skills essential for long-term development. However, above all, they allow for engagement in activities deliberately designed to improve football performance. Evidence suggests that deliberate practice is more likely to lead to elite status when compared with more generic football-related activities and SSGs contribute to this specific area of talent development (Ford, Ward, Hodges, & Williams, 2009; Sarmiento, Anguera, Pereira, & Araújo, 2018; Ward, Hodges, Starkes, & Williams, 2007).

Small-sided games are now a very popular training method in both adult and youth soccer players, however; the usefulness of SSGs was highlighted 30 years ago by the world renowned soccer coach, Carlos Queiroz, who proposed future investigation of SSGs in his academic work, whilst teaching at the Faculty of Human Kinetics in Lisbon, Portugal (Queiroz, 1985). Specifically, Mr. Queiroz stated that future investigations should focus on the quantification of the physical, technical and tactical demands of SSGs when different number of players, pitch sizes, goals and rules are utilised.

The evolution of technological devices (e.g., GPS, Heart Rate monitors, etc.) and the development and validation of new observational tactical instrument tools (Gonzalez-Villora, Serra-Olivares, Pastor-Vicedo, & Da Costa, 2015) help coaches and scientists to study the specific tactical, physiological and biomechanical characteristics of different SSGs and as such the progression of SSG research in soccer has increased exponentially in the last years (Beenham et al., 2017a; Halouani, Chtourou, Dellal, Chaouachi, & Chamari, 2017a; McLean et al., 2016; Sarmiento et al., 2014; Silva et al., 2016). Systematically organizing the contemporary and classic literature on SSG may provide new insights on this method of training. Systematically reviewing research published in refereed journals contributes in several ways, such as informing researchers about the evolution of knowledge on SSGs; the characterization of new techniques for gathering novel information; and offering an evolving theoretical organization of the key topics and concepts researched in SSGs.

Therefore, the aim of this study was to systematically review and organise the literature on soccer SSGs, in order to ascertain the most frequently researched topics, characterise the methodologies, and systematize the evolution of the related research trends.

Methods

Search Strategy: Databases, Inclusion Criteria and Process of Selection

A systematic review of the available literature was conducted according to PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009).

The electronic databases, Web of Science, Pubmed and SPORTDiscus was searched (1th August 2017) for relevant publications using the keywords “football” and “soccer”, each one associated with the terms: “small sided games”, SSG, “drill based training”, “small sided and conditioned games”, “position games”.

The inclusion criteria for these articles were: (1) relevant data concerning technical and tactical evaluation or statistical compilation, and time–motion analysis; (2) participants included amateur and/or professional adult male soccer players; and (3), the articles were published in English. Studies were excluded if they: (1) included females; (2) did not include relevant data for this study; and (3), were conference abstracts.

Two independent reviewers (HS, FMC) independently screened citations and abstracts to identify articles potentially meeting the inclusion criteria. For those articles, full text versions were retrieved and independently screened by the two reviewers to determine whether they met the inclusion criteria. Disagreements about whether the inclusion criteria were met were resolved through discussion with the other authors.

Extraction of Data and Quality of the Studies

To evaluate the quality of the studies, a risk-of-bias quality form (16 items) validated for this specific context of SSG research (see Supplementary Material Table S1) by Sarmiento et al. (2018) was used.

Articles were assessed based on: purpose (item 1), relevance of background literature (item 2), appropriateness of the study design (item 3), sample included (items 4 and 5), informed consent procedure (item 6), outcome measures (item 7 and 8), method description (item 9), significance of results (item 10), analysis (item 11), practical importance (item 12), description of drop-outs (item 13), conclusions (item 14), practical implications (item 15), and limitations (item 16). All sixteen quality criteria were scored on a binary scale (0/1), wherein two of those criteria (items 6 and 13) presented the option: “If not applicable, assume NA”. As in previous research (Sarmiento et al., 2018), to make a fair comparison between studies of different designs, the decision was taken to calculate a percentage score as a final measure of methodological quality. For this, the sum of the score of all items was divided by the number of relevant scored items for that specific research design. The articles were classified as: (1) low methodological quality ($\leq 50\%$); (2) good methodological quality (between 51% and 75%), and; (3) excellent methodological quality ($>75\%$).

A data extraction sheet (adapted from Cochrane Consumers and Communication Review Group’s data extraction template) was developed and tested with ten randomly-selected studies. First, one researcher extracted the data from included

studies and then a second researcher checked the extracted data. Disagreements were resolved by consensus.

Results

Search, Selection and Inclusion of Publications

The initial search identified 394 titles in the described databases. These data were then exported to reference manager software (EndNote X8), and any duplicates (181 references) were eliminated automatically. The remaining 213 articles were then screened according to the title and abstract for relevance, resulting in another 135 studies being eliminated from the database. The full text of the remaining 97 articles were read and another 20 were rejected due to a lack of relevance for the specific purpose of the current study. At the end of the screening procedure, 77 articles received further in depth reading and analysis for the systematic review.

The main reason for exclusion was that a published study included data from other sports ($n = 9$). Other reasons for exclusion included: (1) papers written in a language other than English ($n = 6$); (2) female players ($n = 2$); (3) conference abstracts, and; (4) letter to editor ($n = 1$) (Figure 1).

****Insert Figure 1 here****

The chronological analysis of the articles published no later than 2017 that comprise this review work evidenced the recent development in this area of research, highlighting that more than half (61%) of the studies were published in the last three years (i.e., years 2014 to 2017).

Quality of the studies

The quality of indicators for the included papers was as follows: (1) the mean methodological quality score for the 77 selected articles was 87.38%; (2) none of the articles achieved a maximum score of 100% or scored below 50%; and (3), all the 77 articles achieved an overall rating of >75% (excellent methodological quality).

Potential deficiencies identified in the 77 studies were mainly related to two items on the criteria list: (1) for criterion 16, some studies failed to clearly acknowledge the limitations of the study; (2) some studies lacked information in relation to criterion 5, (i.e., explicit justification of the study sample size).

Data organization

As chronological age can have a significant impact on physical and technical performance, the present review grouped studies according to the following major age categories: Under-11 (9-10 years old), Under-13 (11-12 years old), Under-15 (13-14 years old), Under-17 (15-16 years old), Under 19 (17-18 years old), and Senior (≥ 19 years old). An additional section including papers that compared different variables according to different age groups were also presented. After careful analysis, it was decided that the most appropriate way to present the results would be to categorise them

according to the major research topics that emerged from the analysis. The generality of the studies were focused on the following topics: (1) pitch area; (2)

players number; (3) goal; (4) rules modification/task constraints; (5) training regimen; and (6) coach encouragement (Figure 2).

Two independent reviewers (HS, FMC) classified the papers according to the different major research topics. Disagreements were resolved through discussion with the other co-authors until a consensus was found.

****Insert Figure 2 here****

Age categories

Under-11 to Under-19

Two studies (Castelao, Garganta, Santos, & Teoldo, 2014; Silva, Garganta, Santos, & Teoldo, 2014) investigated the tactical behaviours of under-11 Portuguese teams, using the FUT-SAT observational instrument tool, while Fenner, Iga, and Unnithan (2016) and Joo, Hwang-Bo, and Jee (2016) investigated technical and physiological demands in U-11 and U-13 English and Korean players, respectively. For the U-15 age category there are a considerable number of studies (Almeida, Ferreira, & Volossovitch, 2013; Chaouachi et al., 2014; Clemente, Wong Del, Martins, & Mendes, 2015; Da Silva et al., 2011; Halouani, Chtourou, Dellal, Chaouachi, & Chamari, 2014; Halouani et al., 2017a; Halouani, Chtourou, Dellal, Chaouachi, & Chamari, 2017b; Katis & Kellis, 2009; Köklü, Albayrak, Keysan, Alemdaroğlu, & Dellal, 2013; Silva et al., 2015; Silva et al., 2016) and U-17 category (Christopher, Beato, & Hulton, 2016; Dellal, Jannault, Lopez-Segovia, & Pialoux, 2011; Hill-Haas, Coutts, Rowsell, & Dawson, 2008; Koklu, 2012; Koklu & Alemdaroglu, 2016; Köklü et al., 2015; Los Arcos et al., 2015; Praça, Custódio, & Greco, 2015;

Radziminski, Rompa, Barnat, Dargiewicz, & Jastrzebski, 2013) that assessed the effect of manipulating different conditions (e.g., number of players, pitch size, etc.), on technical, tactical, psychological and physiological responses, using different type of devices (e.g., GPS, Photocell gates, Polar team Sport System) and specific tests (e.g., Yo-Yo intermittent test, Tanner scale) (Table 1).

****Insert Table 1 here****

Comparisons according different ages

A group of Portuguese researchers (Almeida, Duarte, Volossovitch, & Ferreira, 2016; Barnabe, Volossovitch, Duarte, Ferreira, & Davids, 2016; Folgado, Lemmink, Frencken, & Sampaio, 2014) have investigated the influence of age-related soccer practice experience of players on collective and tactical behaviour during SSGs (Teoldo, Garganta, Greco, Mesquita, & Afonso, 2010). Furthermore, Olthof, Frencken, and Lemmink (2015) investigated similar aspects in Dutch players (Table 2).

****Insert Table 2 here****

Senior players

The responses to SSGs in senior soccer players have been tested using diverse approaches. The majority of studies have focused on the acute responses to different SSG formats (number of players), pitch dimensions, task conditions (e.g., limitations on consecutive touches of the ball, use of different goals, floaters, and

tactics) or training regimens (continuous or intermittent, time of recovery, effect of fatigue). However, other studies have analyzed the relationship between SSGs and official matches or compared the effect of SSG training with more traditional training methods (i.e., interval training without the ball). From the 31 articles included in this analysis, three of them compared SSGs with running-based activities (Dellal et al., 2008; Dellal, Varliette, Owen, Chirico, & Pialoux, 2012; Gaudino, Iaia, et al., 2014), three compared SSGs and official 11 vs 11 matches (Casamichana, Castellano, & Castagna, 2012; Dellal, Owen, et al., 2012; Lacome, Simpson, Cholley, Lambert, & Buchheit, 2017), two compared male and female players (Jastrzębski, Radzimiński, & Stępień, 2016; Stevens, De Ruiter, Beek, & Savelsbergh, 2016) and one used SSGs to validate the total body load equation (Gomez-Piriz, Jimenez-Reyes, & Ruiz-Ruiz, 2011). The remaining 22 articles focused on the acute effects of SSGs on physiological, physical, technical or tactical responses.

****Insert Table 3 here****

Different methods were utilized in studies conducted in senior players: (1) analysis of the physiological impact of SSGs using heart rate, blood lactate concentrations and ratings of perceived exertion (RPE); (2) the physical impact of SSGs measured by distance covered at different speeds, and the number of accelerations and decelerations; (3) the technical or tactical impact of SSGs measured by notational systems or tactical measures; and (4) studies that use more than one type of analysis

to identify the effect of SSGs. The studies that only analyzed the physiological impact of SSGs were mainly focused on acute responses or in comparison to running-based activities (Dellal et al., 2008; Dellal, Varliette, et al., 2012; Little & Williams, 2007; Rampinini et al., 2007). The studies that only quantified the physical impact of SSGs predominately compared SSGs with official 11 vs 11 matches, as well as estimating the effect of different SSGs on metabolic power (Casamichana et al., 2012; Gaudino, Alberti, & Iaia, 2014; Lacombe et al., 2017). Lastly, the studies that only analyzed players' technical actions or tactical behavior focused on the influence of different SSGs on individual player behavior (Goncalves, Marcelino, Torres-Ronda, Torrents, & Sampaio, 2016; Guven, Erkmen, Aktas, & Taskin, 2016; McLean et al., 2016). However, the majority of the studies utilized a mixed-method approach, mainly quantifying internal (physiological) and external load (physical), or internal load (i.e., heart rate and RPE) and technical/tactical performance.

****Insert Table 3 here****

Discussion

The aim of this study was to systematically review and organise the literature on soccer SSGs, in order to ascertain the most frequently researched topics, characterise the methodologies, and systematize the evolution of research trends. As chronological age can have a significant impact on soccer performance, the studies were grouped using major age categories in order to compare the influence of SSGs in different age groups.

Number of Players

Assessing the acute effects of player number is the most prevalent topic in SSG research (Clemente, Wong, Martins, & Mendes, 2014; Owen, Wong, McKenna, & Dellal, 2011; Rampinini et al., 2007). Lower player numbers (i.e., 1vs1 [extreme] to 4vs4 [small-sided]) significantly increases the physiological demand compared to medium-sided games (5vs5 to 8vs8) or large-sided games (> 9vs9) (Katis & Kellis, 2009; Little & Williams, 2007; Owen et al., 2011). Heart rate, blood lactate concentrations and RPE are commonly higher in 1vs1 to 4vs4 games, independent of age category (Aguiar, Botelho, Goncalves, & Sampaio, 2013; Dellal, Jannault, et al., 2011; S. Hill-Haas et al., 2008; Katis & Kellis, 2009). Studies conducted in senior players reveal values between $\sim 90\%HR_{max}$ during extreme-sided games to $85\%HR_{max}$ during small-sided games, with a progressive decrease to $81\%HR_{max}$ in large-sided games (Dellal, Chamari, et al., 2011; Little & Williams, 2007). In youth categories, the results provide contrasting results. Koklu and Alemdaroglu (2016) verified that in terms of $\%HR_{max}$, 3-a-side and 4-a-side games elicit significantly higher values than 2-a-side games, while Koklu (2012) demonstrated that 3-a-side SSGs (played intermittently and continuously) result in higher HR's compared to 2- and 4-a-side games. Nevertheless, results from other studies demonstrate an inverse relationship between the number of players and the physiological response in differing formats of SSG (Da Silva et al., 2011; Dellal, Jannault, et al., 2011; Katis & Kellis, 2009).

Assessing the physical impact of SSGs is difficult, as the majority of investigations do not report values relative to the duration of exercise (i.e., m/min or no. of sprints per min). Of those investigations that have reported relative data, some have observed more distance covered per min with a higher number of players

(Clemente, Wong, et al., 2014; Dellal, Chamari, et al., 2011) whilst others have observed higher distance per min in smaller-sided games (Clemente, Nikolaidis, Van Der Linden, & Silva, 2017; Lacome et al., 2017; Owen, Wong, Paul, & Dellal, 2014). Additionally, with few exceptions (Joo et al., 2016), some confounding factors are not accounted for (both in youth and senior ages) in different studies, namely: (1) maturational status; (2) time of recovery between official matches and between training sessions; (3) time played in official matches before the SSGs testing; (4) level of playing experience.

Finally, there is an increase in the number of technical actions performed per player with smaller team sizes (Almeida et al., 2013; Clemente, Wong del, et al., 2014; Joo et al., 2016; Katis & Kellis, 2009; Owen et al., 2014) and consistency in specific tactical behaviours (Castelao et al., 2014; Silva et al., 2014). The study of Da Silva et al. (2011) using U-15 players, showed that team size does not influence number of passes, tackles, and headers, but the number of dribbles, crosses and shots on goal increase during smaller games (3vs3 compared with 4vs4 and 5vs5). In contrast, small-sided games with smaller number of players (Joo et al., 2016) may involve a higher amount of technical actions without excessive physical demands. In a study by (Teoldo et al., 2010), as age group increases, the greater the player participation in a game, performing more (quantitative) tactical actions. As regards the qualitative performance, this study also showed that U-17 and U-20 groups exhibited the biggest differences in the tactical performance indices when they were compared with U-13 and U-15 groups.

Interestingly, in a study that investigated numerically-unbalanced formats on tactics, the use of floaters (players that provide numerical superiority for a given

team) stimulates the emergence of new patterns, to try and counteract the influence of the numerical balance. This may help simulate real scenarios of official 11-a-side format, including when players are sent off and thus reducing the number of active players (Ric et al., 2016). Another study that compared the stability of tactical behaviours during games with numerical unbalance found that the use of superiority or inferiority of playing personnel number may enhance individual and team auto-organization and thus stimulate the collaborative process of teams (Goncalves et al., 2016). Furthermore, it has been observed that unbalanced teams result in smaller distances covered by youth players, as well as the number of accelerations performed (Praça et al., 2015).

As a practical implication, it must be highlighted that extreme and small-sided games (up to 4 vs. 4) seem to be played at a high intensity, taxing the glycolytic system and improving anaerobic capacity. However, extreme sided-games (1 vs. 1 or 2 vs. 2) are not useful for tactical development. An increase in the number of players (bigger formats) will decrease the acute physiological intensity but will allow to augmentation of tactical training. Coaches should choose the appropriate size of games in accordance with the main goal of the training session.

Pitch area

The demands of SSGs can be influenced by the variation of the total (absolute and relative) area of the pitch. The relative pitch area per players is defined as the total pitch area divided by the total number of players (Hill-Haas et al., 2011). The majority of studies reveal that larger areas lead to an increase in acute physiological load (heart rate, blood lactate and RPE) compared to smaller pitches, independent

of game-format and age category (Hodgson, Akenhead, & Thomas, 2014; Köklü et al., 2013; Little & Williams, 2007; Rampinini et al., 2007). The studies that analysed different pitch areas in 3vs3, 4vs4, 5vs5, 6vs6 and 7vs7 are unanimous in their conclusions that larger areas (above 100 m² per player) statistically increase the heart rate responses, blood lactate concentrations and perceived exertion in both youth and senior players (Hodgson et al., 2014; Kelly & Drust, 2009; Köklü et al., 2013; Rampinini et al., 2007). The number of studies investigating the physical impact of using different pitch dimensions is low, however; a study conducted in U-17 players revealed that increased distances and higher distances in high-speed running were covered in the two bigger area dimensions (175 and 273 m² per player) employed (Casamichana & Castellano, 2010). Similar observations have been made in collegiate players, with the two bigger area dimensions (120 and 200 m² per player) led to increased total running distance, as well as the total number of accelerations and decelerations (Hodgson et al., 2014).

In the same investigation, Hodgson et al., (2014) demonstrated that during 4vs4 SSGs, a smaller pitch size causes an increased number of passes, shots and tackles. In U-15 players (Almeida et al., 2013; Da Silva et al., 2011; Katis & Kellis, 2009), during SSGs with a larger pitch size, the number of actions that each player perform on the ball tends to decrease, increasing the number of “off-the-ball” movements (Almeida et al., 2013). Joo et al. (2016) suggested that a smaller number of players with smaller pitch size may reduce the physical demand of youth players. This may be beneficial to coaches who are looking to control the physical load imposed on their players.

From a tactical point-of-view it was found in 4v4 SSGs that shorter pitches result in smaller longitudinal inter-team distance and surface area (Frencken, Van Der Plaats, Visscher, & Lemmink, 2013). However, (Castelao et al., 2014; Silva et al., 2014) analyzed tactical behaviour during different SSGs, with alterations in pitch size and game duration. The tactical demands are different according the type of the SSG in this age (U-11). According to Castelao et al. (2014) a 3vs3 SSG configuration promotes greater individual actions of players within the centre of play, such as dribbling/carrying the ball, while 5vs5 required more positional play and coverage of spaces outside the centre of play. Similarly, Silva et al. (2014) showed that players have more aggressive behavior during 3vs3 whilst acting more safely in 6vs6 configuration. This difference in behavior seems related to the limitation on available space and decreased complexity of 3vs3; which involves fewer interactions between players (colleagues and opponents).

Briefly, and despite no clear evidence related to the acute physiological effects of pitch dimensions, it appears that bigger pitches are more adequate for increasing the physical demand of the games, while also allowing for tactical principles associated with longitudinal and lateral exploration to be developed. The consequences of bigger sizes can be a decrease in the number of technical actions, however coaches should consider adjusting the pitch dimensions per the main goals of the training session.

Goals

The use of different type of goal posts or targets influence the tactical behaviour of players and the consequent physiological and physical impact (Clemente, 2016). A

study conducted in U-15 players tested two types of scoring: stop the ball versus small-goal rules and observed that the stop-ball significantly increased player heart rates and blood lactate concentrations (Halouani et al., 2014). A study conducted in U-19 players tested the effects of a ball possession game without goals, a ball possession game with two floaters, and a regular game with goalkeepers (Mallo & Navarro, 2008). The authors observed that playing with standard goals led to a decrease in distances covered and reduced heart rates (Mallo & Navarro, 2008). In amateur players, greater physiological load (heart rate responses) is observed during imposed conditions of scoring by crossing the endline or crossing two small goals compared to scoring in one small goal (Clemente, Wong, et al., 2014). No significant differences in technical actions have been observed due to adjustment in goal type (Clemente, Wong, et al., 2014). Finally, the use (or not) of goalkeepers has been investigated (Köklü et al., 2015). Significantly greater heart rates, blood lactate concentrations, ratings of perceived exertion, and distances covered at different speeds were observed without a goalkeeper, thus suggesting that the use of small-goals may be a more appropriate method if the aim is to increase the acute physiological impact and physical demands of the game (Köklü et al., 2015).

Despite the small number of studies that have compared scoring methods, the data suggests that using small goals and different types of scoring may significantly increase the physiological impact in comparison with traditional formats of goal and goalkeeper. As such, goal type and the use of a goalkeeper can be utilised by coaches to manipulate the physiological demands of a SSG training session.

Rules modifications/Task constraints

Specific adjustments are made to the design of SSGs in order to increase the tactical or technical load of a game (Davids et al., 2013) or to effectively manage effort (Clemente, Martins, & Mendes, 2014). Constraining the number of consecutive touches on the ball, the type of defensive marking, or the specific tactical setup may lead to different player decisions and performances. As such, rule modifications are typically used by coaches (Aguiar et al., 2012).

Limiting ball touches per possession aims to increase the speed of the game and ball circulation between teammates (Casamichana, Suarez-Arrones, Castellano, & San Roman-Quintana, 2014; Dellal, Chamari, et al., 2011; San Román-Quintana et al., 2013), as well as the distance and speed movement of the opponents. This specific rule modification has been tested with data suggesting that limitation of consecutive number of touches in comparison to free-play significantly increases the acute physiological responses, with increased heart rate, blood lactate concentrations and rating of perceived exertion (Dellal, Chamari, et al., 2011; San Román-Quintana et al., 2013). Only one study, which utilised 6vs6 SSGs, did not confirm these findings (Casamichana et al., 2014).

The physical impact of limiting touches on the ball has been also tested (Dellal, Chamari, et al., 2011), with equivocal findings. A study using 2vs2 to 4vs4 formats in elite players revealed significantly greater distance covered when there was touch limitation (Dellal, Chamari, et al., 2011). The opposite was found in 6vs6 and 7vs7 formats played by amateur players (Casamichana et al., 2014; San Román-Quintana et al., 2013). Some reasons for these inconclusive results may be related to the specific format of the game, time duration of the games and the quality of players (professional vs. amateurs).

Changes in technical performance during limited touch conditions have been observed, with more possessions occurring in one touch situations, and more successful passes and number of duels occurring in two ball touches and free play conditions across 2vs2, 3vs3 and 4vs4 formats (Dellal, Chamari, et al., 2011).

The use of different types of marking (i.e., man-to-man, double marking, zonal) is also a task constraint used in SSGs (Clemente, 2016). In a study conducted in amateur players across 3vs3, 6vs6 and 9vs9 formats heart rates and distance covered were increased in man-to-man marking (Casamichana, Román-Quintana, Castellano, & Calleja-González, 2015). Similarly, in youth players, comparisons between free-play and two types of marking revealed greater effort measured by heart rate, RPE and distances covered in man-to-man and double man marking conditions (Cihan, 2015).

In summary, different rule modifications may lead to differential responses during sided-games. A limited number of touches and instructions to mark man-to-man are concurrent conditions that increase the acute physiological load and the physical demands of the match, whilst leading to an increase in the execution of individual technical actions during the matches.

Training regimen

Some studies have compared continuous SSGs with intermittent SSGs (Casamichana, Castellano, & Dellal, 2013; Fanchini et al., 2011; Koklu, 2012). A study conducted in amateur players tested different intermittent regimens (3x2 min, 3x4 min and 3x6 min) in 3vs3 format (Fanchini et al., 2011). In this study, heart rate responses were significantly lower in 6-min games compared to 4-min. No

effects of duration on technical performance were observed (Fanchini et al., 2011). The comparison of intermittent versus continuous 5v5 games in amateur Spanish players suggested that continuous games may lead to greater physical loads than during intermittent games, but without significant differences in heart rate responses (Casamichana et al., 2013). Using U-17 players (Koklu, 2012) compared continuous versus intermittent games in 2vs2 (3x2 min versus 6 min), 3vs3 (3x3 min versus 9 min) and 4vs4 (4x4 min versus 12 min) formats. There were no observed differences between continuous versus intermittent in all formats of the game, thus suggesting that both intermittent and continuous games can be used for to stimulate aerobic endurance adaptations in U-17 players (Koklu, 2012).

The patterns of effort observed during SSGs are similar to an intermittent training program. Smaller formats should be conducted with a larger number of bouts and a smaller time per bout. However, medium- to large-sided games may be longer in duration but with a reduced number of bouts. In the biggest sided-games (9 vs. 9 or 10 vs. 10) continuous bouts may be conducted based on a low level of intensity in comparison to smaller formats.

Coach Encouragement

A study conducted using 3vs3, 4vs4, 5vs5 and 6vs6 SSGs tested the influence of using or not using coaches' verbal encouragement (Rampinini et al., 2007). The authors observed significant higher values of heart rate, blood lactate concentrations and perceived exertion on the conditions played with coaches' verbal encouragement (Rampinini et al., 2007). Further research is required to assess the influence of coach encouragement on the physiological, physical,

technical and tactical responses during SSG. To the author's knowledge, no investigations have been conducted on these latter three types of response.

Despite the few available studies, encouragement should be used during SSGs that are designed to elicit high-demanding efforts, otherwise it is not strictly necessary.

Others

Within younger age groups Fenner et al. (2016) evaluated, for the first time, prepubertal players' talent potential using multiple SSG (4vs4), and concluded that the more talented English players are more successful during SSG regardless of team combination. These talented youth players were also the same players rated highly by coaches and played the SSGs at a higher speed and covered greater distances than the less talented players. Additionally, a study carried out by Teoldo and colleagues (Teoldo, Garganta, Greco, Mesquita, & Seabra, 2010) examined the associations between tactical performance and birth date of youth soccer players. The authors demonstrated that players who were born at the beginning of the year were more likely to have better defensive tactical performance, whilst players were born at the end of the year performed better offensive tactical behaviors. These results should be considered by coaches when analyzing the tactical behavior of players and if SSGs can be used to manipulate and change behavior.

Conclusion

SSGs are extensively used in soccer due to their multifunctional nature including the ability to stimulate an increased intensity compared to a full match, whilst subsequently developing specific tactical contents. Nevertheless, the acute

understanding of their effectiveness has only recently been subject to empirical study by the scientific community. The increasing number of studies published in recent years allows for a better understanding of the complex relationship between technical, tactical and physiological interactions in SSGs and how the manipulation of these variables improve the soccer training process and allow coaches a better understanding of SSG programming.

Although the different study designs (e.g, different pitch sizes, number of players, specific rules, and duration bouts, etc.) provide a broader knowledge about the possible manipulations of the previously mentioned variables, there is a lack of consistency between studies, thus making it difficult to extrapolate the results from specific groups of players (i.e., varying ages and quality level). We believe that the requirements (technical, tactical, psychological, etc.) of a specific SSG with the same constraints (e.g., pitch area, number of players, rules, etc.) are very different for a group of top elite players compared to a group of amateur players, as well as for different competitive levels in the youth age-groups. Additionally, the reviewed studies, in general, make use of small groups of players (in a specific moment) to investigate the effect of the different variables and, in most cases, the players are from lower competitive levels. In this sense, future research should also include high level players and bigger samples using more longitudinal study designs, thus making it possible to control some of the aforementioned confounding factors.

Tactical and strategical aspects are often underestimated in these types of studies. Although the physiological and physical loads imposed by SSGs are important factors to consider, the tactical and strategical implications of SSG manipulation, and the transferability to official game-specific situations should also be empirically

investigated. Moreover, the emotional aspects of the official game also need to be explored in the SSGs. Coaches regularly make adjustments to SSGs during training sessions, and as such, sports scientists and researchers should help them to quantify the effectiveness of their interventions.

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Table 1. Studies that investigated Small Sided Games in youth players

Study	Sample	Aim	SSGs Format	Pitch Dimensions (m)	Area per players ^a (m ²)	Training prescription	Rules	Analysed variables	Instrument for analysis	Quality Score (%)
UNDER-11										
<i>Castelao et al. (2014)</i>	10 U-11 Portuguese Players	Compare the tactical behaviours and performance of soccer players in 3vs3 and 5vs5 small-sided games	3vs3 +GK 5vs5 +GK	36x27 60x45	121.5 245.5	1x7.2min continuous 1x7.2min continuous	- Official rules of association football, with the exception of the offside rule.	Tactical behaviours	-Video camera -FUT-SAT	80.00
<i>B. Silva et al. (2014)</i>	18 U-11 Portuguese Players	Compare players' tactical behaviour in 3vs3 and 6vs6 soccer small-sided games	3vs3 +GK 6vs6 +GK	30x19.5 60x39	73.1 180	1x8min continuous 1x8min continuous	---	Tactical behaviours	-Video camera -FUT-SAT	80.00
<i>Fenner et al. (2016)</i>	16 U-10 English Players	-Evaluate physiological and technical attributes of prepubertal soccer players during multiple small-sided games (SSGs), and determine if SSGs can act as a talent identification tool.	4vs4 (2mx1m) ^b	18.3mx23m	52.5	6x5min/3min rest	- No verbal encouragement or feedback was allowed from coaches throughout the session.	Game Technical Scoring Work rate	GPS Technical scoring chart	93.33
UNDER-13										
<i>Joo et al. (2016)</i>	149 U-13 Korean Players	- Examine the technical aspects and physical demands during SSGs with different sized pitches.	8vs8 ^c 8vs8 ^c 11vs11 ^c	68x47 75x47 75x47	199.8 220.3 160.2	1x30min with 10 min overtime	- The Korea Football Association official soccer rules were strictly applied. -Verbal encouragement or feedback was allowed from coaches throughout the session.	Technical aspects Physical demands	Video tracking system	93.33
UNDER-15										
<i>Almeida et al. (2013)</i>	28 U-15 Portuguese participant s (14 non-experience d soccer players and 14 experience d soccer players	- Analyze the interaction and main effects of deliberate practice experience and small sided game format (3 vs. 3 and 6 vs. 6 plus goalkeepers) on the offensive performance of young soccer players	3vs3 +GK 6vs6 +GK	46x31 62x40.4	178.3 178.9	3 independent sessions separated by one-week interval 1x10min (5m+5m/1minrest) /5min rest for each SSG	- Official rules of soccer were implemented apart from the offside rule. -Verbal encouragement or feedback was not allowed from coaches throughout the session.	Deliberate practice Offensive performance (Technical aspects)	Video camera and specific observational instrument tool	86.67
<i>Clemente, Wong Del, et al. (2015)</i>	10 U-15 Portuguese Players	- determine the effects of different formats and task conditions in small-sided conditioned games on young soccer players' heart rate	1vs1+1 2vs2+1 Both played at three task conditions	20x15 28x18	~100 ~100	3x3 min/3 min	The floater only provided attacking coverage to the player(s) in attack. Official rules of soccer were implemented apart	Heart rate (%HRres) Distance coverage (km) Speed (m/s)	HR monitor with GPS (RC3GPS, Polar)	93.33

		responses and time-motion profiles	: T1 (no goal), T2 (no goal but endline) and T3 (small goal)				from the offside rule. Verbal encouragement or feedback was not allowed from coaches throughout the session.	Acceleration (m/s ²)		
<i>Da Silva et al. (2011)</i>	16 U-15 Brazilian soccer players	-Examine: i) the effect of varying the number of players on exercise intensity and technical actions during SSGs; ii) the reliability of exercise intensity and technical actions, and; iii) the influence of the players' maturation on EI and involvements with the ball.	3vs3 (1.2mx0.8 m) ^b 4vs4 (1.2mx0.8 m) ^b 5vs5 (1.2mx0.8 m) ^b	30x30 30x30 30x30	150 112.5 90	3x10min /3min rest for each SSG	- Without Goalkeepers. -Verbal encouragement or feedback was not allowed from coaches throughout the session.	Maturity status Technical aspects Heart Rate	Tanner Scale Polar Team System Video camera and specific observational instrument tool	93.33
<i>Halouani et al. (2014)</i>	12 U-15 soccer players	- Examine the effects of stop-ball-SSG vs. small-goals-SSG rules on physiological responses during a 3 vs. 3 SSG in young soccer players.	3vs3 (scoring zone) 3vs3 (1mx0.5m) ^b	20x15 20x15	50 50	4x4min /2min rest for each SSG	- The defenders were not allowed to impede goals with their hands. - Defenders were instructed to move and not allowed to stay nearby the goal (i.e., 2 m). -Verbal encouragement or feedback was allowed from coaches throughout the session.	Heart Rate Lactate concentrations Rating of perceived exertion (RPE)	Polar S-810 RPE – 10 point Scale (Foster et al., 2001) Lactate Pro (Arkray, Japan)	93.33
<i>Halouani et al. (2017a)</i>	12 U-15 soccer players	-Examine the effects of variations in pitch dimensions on pre-adolescent youth soccer players' physiological responses during two different types of small-sided games	4vs4 (scoring zone) 4vs4 (1mx0.5m) ^b	10x15 15x20 20x25	18.8 37.5 62.5	4x4min /2min rest for each SSG	- The number of ball contacts allowed was free. - Participants were asked to defend and attack and no goalkeepers were used. -Verbal encouragement or feedback was allowed from coaches throughout the session.	Heart Rate Lactate concentrations Rating of perceived exertion (RPE)	Polar S-810 RPE – 10 point Scale (Foster et al., 2001) Lactate Pro (Arkray, Japan)	93.33
<i>Halouani et al. (2017b)</i>	18 U-15 soccer players	- Examine the influence of 3 forms of players' number (2vs2, 3vs3, 4vs4) during Stop -Ball and Small-Goal rules on the physiological responses of young soccer players.	2vs2 ^d 3vs3 ^d 4vs4 ^d (scoring zone) (1mx0.5m) ^b	20x25	62.5	4x4min /2min rest for each SSG	---	Heart Rate Lactate concentrations Rating of perceived exertion (RPE)	Polar team Sport System RPE – 10 point Scale (Foster et al., 2001) Lactate Pro (Arkray, Japan)	86.67

<i>Katis and Kellis, (2009)</i>	34 U-15 soccer players	To examine: i) the movement actions performed during two different small-sided games; their effect on a series of field endurance and technical tests	3vs3	15x25	62.5	4x4min /3min rest ^e	-Free touches - A necessary requirement for scoring goals was that all players should be in the opponent's half. - Coach encouragement using standardized instructions was allowed.	-Technical aspects - Physical aspects - Heart Rate	- Specific observational instrument tool - Video camera - Illinois test (agility) -Soccer Throw-in test; - Sprint test - Dribbling test -Horizontal Jump test	93.33
			6vs6	30x40	100	4x4min /3min rest ^e				
<i>Köklü et al. (2013)</i>	16 U-15 soccer players	To examine the acute effects of the pitch size on the physiological responses of young soccer players during the two most traditional SSG	3vs3	20x15	50	4x3min /2min rest ^e 4x4min /2min rest ^e	- Without goalkeeper - Coach encouragement using standardized instructions was allowed.	-Heart Rate -Rating of perceived exertion (RPE)	-Yo-Yo intermittent recovery test level 1 - Polar Team Sport System - RPE – 10 point Scale (Foster et al., 2001)	86.67
				25x18	75					
				30x20	100					
			4vs4	20x20	50					
<i>Silva et al. (2015)</i>	24 U-15 Portuguese soccer players	Analyze how the same relative spaces per player, obtained through manipulations of player numbers and field dimensions, influenced inter-individual coordination.	6vs6	52.9x34.4	152	3x6min /4min rest ^e	- Without goalkeeper - Coach encouragement was not allowed. - Official rules of association football, with the exception of the offside rule.	- Effective relative space per player; - Radius of free movement; - Numerical relations inside each player's relative space per player; - Players' spatial distribution variability.	- GPS (10HZ) devices.	86.67
			7vs7	49.5x32.2	133					
			8vs8	46.7x30.3	118					
			9vs9 (scoring zone – 8m)	57.3x37.1	152					
				57.3x37.1	133					
<i>Silva et al., (2016)</i>	10 U-15 Portuguese soccer players	To investigate how practice in SSCG shapes emergent tactical behaviours by analysing the influence of different values of relative space per player on the spatial-temporal characteristics of inter-team coordination.	3vs3		168	-Time duration was set by the coach based on the usual duration of other types of SSCGs that was implemented in training sessions	- Without goalkeeper - Coach encouragement was not allowed.	- Players' dispersion: i) overall; ii) in the goal-to-goal-direction; iii) in the side-to-side direction; - Time delay between teams' movements in the side-to-side direction; - Coupling strength: i) in the goal-to-goal-direction; ii) in the	- GPS (15HZ) devices	86.67
			4vs4	36x28	126					
			5vs5 (1,2mx0,8 m) ^b		101					

								side-to-side direction.		
<i>Chaoua chi et al. (2014)</i>	36 U-15 Tunisian soccer players	-Compare the training effects of a small-sided game (SSG) and multidirectional sprint intervention on agility and change of direction (COD) ability in young male soccer players.	1vs1	10x20	154	-Different times across different weeks.	-Ball contacts were restricted to 3 and 2 for the 1vs1, 2vs2, and 3vs3 conditions, respectively, and no goalkeeping was considered.	-Maturity status; -Multidirectional sprint intervention on agility and change of direction	-Photocell gates -Tanner's pubic hair technique; - Zig-zag test over 20 m (Z-20 m) -Reactive Agility Test protocol -Force platform	86.67
			2vs2	20x20	100					
			3vs3	20x30	100					
UNDER -17										
<i>Hill-Haas et al. (2008)</i>	16 U-17 soccer players	- Examine the variability in physiological and perceptual responses and time—motion profiles of various SSG formats (2vs2, 4vs4, 6vs6) and regimes (interval and continuous).	2vs2	28x21	147	Continuos regimen 1x24min	-Verbal encouragement or feedback was allowed from coaches throughout the session.	-Heart Rate -Rating of perceived exertion (RPE) - Blood lactate - Time-motion characteristics	- Polar Team Sport System - RPE – 6-20 Borg Scale - Blood-gas analyser (ABL 625 Radiometer) -GPS (10HZ) devices	80.00
			4vs4	40x30	150	Interval regimen 4x6min /1.5min rest ^e				
			6vs6	49x37	151					
<i>Casamich ana and Castellano(2010)</i>	10 U-17 soccer 1 players	- Analyze physiological and physical impact of different pitch dimensions in SSGs	5vs5+GK	32x23	73.6	8 min	- Official rules of association football, with the exception of the offside rule	- Heart rate (mean and %HRmax) - Total distance at different speeds - Maximum speed - Technical actions (tackle, interception, control, dribble, pass, shot, header)	HR monitor (Polar Team Sport System) 1Hz GPS (SPI-elite, GPSport) Measuring and Observation Tool in Sorts	86.67
				50x35	175					
				62x44	272.8					
<i>Dellal, Jannault, et al. (2011)</i>	27 U-17 French soccer players	- Compare heart rate responses within and between SSG training methods in elite young soccer players.	2vs2	20x25	125	8x2min /1min rest	- No goalkeepers. - No goals. - SSG were performed according the “stop-ball” rules - All the players of the team had to be located in the offensive side of the pitch to validated the point. -Verbal encouragement or feedback was allowed from coaches throughout the session.	-Heart Rate -Blood lactate	- Polar (RS800, Polar Electro). - Lactate Pro device (Arkray Inc, USA) - VAMEVAL test (Cazorla and Léger, 1993)	86.67
			3vs3	25x30	125	6x3min /1.5min rest				
			4vs4	28x35	122.5	4x4min /2min rest				

<i>Köklü et al. (2011)</i>	16 U-17 soccer players	- Compare the blood lactate, heart rate and percentage of maximum HR responses among the SSGs in elite young soccer players	1vs1	6x18	54	6x1min /2min rest	-Verbal encouragement or feedback was allowed from coaches throughout the session. - No goalkeepers.	-Heart Rate -Maximum Heart Rate (%HRmax) -Blood lactate -Physical and physiological features	-YSI 1500 SPORT lactate analyzer. - Polar S810 HR monitors - YoYo Intermittent Recovery Test, level 1	86.67
			2vs2	12x24	72	6x2min /2min rest				
			3vs3	18x30	90	6x3min /2min rest				
			4vs4	24x36	108	6x4min /2min rest				
<i>Koklu (2012)</i>	20 U-17 soccer players	- Investigate physiological responses to various intermittent and continuous SSGs (2vs2, 3vs3, 4vs4) in young soccer players.	2vs2	15x20	75	3x2min ^f	-Verbal encouragement or feedback was allowed from coaches throughout the session. - No specific rules were utilized in the games to influence their intensity. - No goalkeepers.	-Heart Rate -Maximum Heart Rate (%HRmax) -Blood lactate -Physical and physiological features	-YSI 1500 SPORT lactate analyzer. - Polar S810 HR monitors - Yo-Yo Intermittent Recovery Test, level 1	80.00
			3vs3	18x24	72	3x3min ^f				
			4vs4	24x36	108	4x3min ^f				
						Continuous – 1x6,9 and 12min for 2vs2, 3vs3, and 4vs4 SSGs, respectively				
<i>Radzimin ski et al. (2013)</i>	20 U-17 soccer players	- Investigate the effects of high intensity interval running and small-sided game training programs on the physical capacity and the level of soccer-specific technical skills in young soccer players.	3vs3 + neutral player	18x30	77	5x4min /3min rest	-The neutral player was always playing with the team in possession of the ball. -Verbal encouragement or feedback was allowed from coaches throughout the session.	-VO ₂ max -VO ₂ at AT -Peak power -Technical variables -Agility -Speed	- Double photocells - Cycle ergometer - Deutsche Fussball Bund Test; - Wingate test; - Heart rate monitors (Polar Electro)	93.75
<i>Köklü et al. (2015)</i>	16 U-17 soccer players	-Compare %HRmax, RPE, and Lactate responses, and distances covered at different speeds in 2vs2, 3vs3 and 4vs4 soccer games played with and without goalkeeper.	2vs2 ^G	15x27	101.2	4x2min/2min rest	- SSGs were performed with the instruction to maintain collective possession of the ball for as long as possible. -Verbal encouragement or feedback was allowed from coaches throughout the session.	-Heart Rate -Maximum Heart Rate (%HRmax) -Blood lactate -Physical and physiological features -Rating of perceived exertion (RPE)	-Polar Team Sport System -Lactate Plus - RPE – 10 point Scale (Foster et al., 2001) -GPS (15HZ) devices - Yo-Yo Intermittent Recovery Test, level 1	87.50
			3vs3 ^G	20x30	100	4x3min/2min rest				
			4vs4 ^G	25x32	100	4x4min/2min rest				

<i>Los Arcos et al. (2015)</i>	16 U-17 Spanish soccer players	-Compare the effects of SSGs vs. Interval Training in soccer training on aerobic fitness and physical enjoyment in youth elite soccer players	4vs4 variants of F _{off} , F _{in} , GK and number and size of goals were introduced	Not provided	85	3x4min/3min rest	- Scores were considered valid only if made with the first touch - Floaters were excluded from the pitch size calculation	- VO ₂ máx -Physical enjoyment	-Polar Team Sport System 2 - CMJ test - Université de Montréal Tract Test (UM-TT) -Physical Activity Enjoyment Scale (PACES)	87.50
<i>Praça et al. (2015)</i>	16 U-17 Brazilian soccer players	-Compare the physical demands of 3vs3, 4vs3 (additional player in the attacking team) and 3vs3+2 (two supporting players around the field) SSGs.	3vs3 (6mx2m) ^b 3vs3 +2 (6mx2m) ^b 4vs3	36x27 36x27 36x27	162 162 138.9	2x4min/4min rest	-Physical demands	- All formal rules were followed. -In the 4vs3 configuration, the additional player (allayas attck for the attacking team) was allowed to perform actions shared by the remaining players. in the 3vs.3+2 configuration, the two athletes positioned around the field could only perform two consecutive touches during individual ball possession. These players also always acted for the attacking team and their movements were restricted to the sides of the soccer field.	-GPS (5HZ) devices -Procedural Tactical Knowledge Test: Sports Orientation (PTKT-SO)	86.67
<i>Christopher et al., (2016)</i>	16 U-17 English soccer players	-Examine how the manipulation of exercise to rest ratio, within the same overall duration, affected both physical and technical outcomes during SSGs in elite youth soccer.	6vs6	50x32	133.3	1x8min 2x4min/1min rest 4x2min/45-60s rest	- Official rules of association football, with the exception of the offside rule. -Verbal encouragement or feedback was allowed from coaches throughout the session.	-Physical demands -Heart Rate -Rating of perceived exertion (RPE) -Technical aspects	- Polar T31 HR monitors -GPS (15HZ) devices - RPE – 10 point Scale (Foster et al., 2001) -Video camera and specific observational instrument tool	86.67

<i>Koklu and Alemdaroglu (2016)</i>	40 U-17 soccer players	-Compare the percentage of maximum heart rate (%HRmax), blood lactate, and rating of perceived exertion responses across different formats of SSGs in elite young soccer players.	2vs2 3vs3 4vs4	12x24 18x30 24x36	72 90 108	2x8min/2min rest 3x8min/2min rest 4x8min/2min rest	-Teams were instructed to maintain collective possession of the ball for the longest time possible. No goalkeepers were involved. -Verbal encouragement or feedback was allowed from coaches throughout the session.	-Heart Rate -Blood Lactate -Rating of perceived exertion (RPE)	- Polar S810 HR monitors - Lactate Plus analyzer - Yo-Yo Intermittent Recovery Test, level 1 - RPE – 10 point Scale (Foster et al., 2001)	86.67
<i>UNDER-19</i>										
<i>Mallo and Navarro (2008)</i>	10 U-19 players	Analyze the influence of different goals on physiological, physical and technical impact	3vs3	33x20	110	5 min	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (mean, %HRmax) Distance covered at different speeds Technical actions (contacts with ball, short distance passes, error in short distance passes, shots on goals)	HR monitor (Polar Accurex Plus) 2D-DLT bases algorithm to tracking system and videorecording	80.00
<i>Kelly and Drust (2009)</i>	8 U-19 male soccer players	Analyze the influence of changing pitch dimensions on heart rate responses and technical demands	4vs4+GK	30x20 40x30 50x40	75 150 250	4x4 min/2 min	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (mean) Technical actions: pass, receive, turn, dribble, header, tackle, interception, shot and target pass	HR monitor (Polar Team System) Camcorder and notational system	86.67
<i>Frencken, et al. (2011)</i>	10 U-19 players	Identify an overall game pattern during SSGs	4vs4+GK	36x28	126	3x8 min/2 min	- Official rules of association football, with the exception of the offside rule.	Centroid (x, y and radial) Surface area (length, width and area)	45Hz local position measurement system (Inmotio Object tracking BV)	86.67
<i>Aguiar et al., (2013)</i>	10 U-19 players	Identify the acute physiological responses and activity profiles of SSGs	2vs2+GK 3vs3+GK 4vs4+GK 5vs5+GK	Not revealed	150	3x6 min/1 min	- Official rules of association football, with the exception of the offside rule.	RPE Heart rate (%HRmax and time per intervals) Total distance Sprints/Athlete Accumulated load	6-20 Borg scale HR monitor (Polar Team System) 5Hz GPS (SPI-PRO, GPSport)	80.00
<i>Ade et al. (2014)</i>	16 U-19 players	Compare speed-endurance-production and speed-endurance-maintenance drills	1vs1 2vs2	27x18	243 ~122	8x30 sec/120 sec 8x60 sec/60 sec	- Official rules of association football, with the exception of the offside rule and	Heart rate (%HRmax and %HRpeak) Blood lactate (mmol/L)	HR monitor (Polar Team System) Lactate Pro 6-20 Borg scale	86.67

							scoring method (two small goals)	RPE Total distance High-speed running Very-high speed running High acceleration High deceleration	10Hz GPS (MinimaxX S4)	
<i>Silva et al. (2014)</i>	20 U-19 players	Analyze the effects of different numerical relations in SSGs	5vs3+GK 5vs4+GK 5vs5+GK	47.3x30.6	~181 ~161 ~145	6 min/6 min	- Official rules of association football, with the exception of the offside rule and scoring method	Major ranges Stretch index Centroid's distance to goal center	15Hz GPS (SPI-Pro, GPSport)	86.67
<i>Cihan (2015)</i>	18 U-19 players	Analyze the effects of different defensive strategies on physiological responses and physical demands	3vs3 Played at conditions of free play, man-to-man marking and double-man pressure	35x20	116	3x4 min	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate RPE (CR-10 scale) Distances at different speeds	HR monitor (Polar Team Sports System) CR-10 Borg scale GPS (SPI-Elite, GPSport)	93.33
<i>Asci (2016)</i>	22 U-19 players	Compare the heart rate responses between SSGs and official matches	3vs3+GK 4vs4+GK 5vs5+GK 7vs7+GK 9vs9+GK 10vs10+GK	25x20 35x30 45x30 55x40 70x40 105x65	83 131 135 157 155 341	6x2 min ^f 4x3 min ^f 3x4 min ^f 2x6 min ^f 2x8 min ^f 1x90 min ^f	- Official rules of association football, with the exception of the offside rule	Heart rate (mean and %HRmax)	HR monitor (Polar Team Sport System)	93.33
<i>Aguiar et al. 2017)</i>	10 U-19 players	Analyze the regularity of the player's interpersonal positioning and the association with short and long sequences of play	5vs5+GK	44x34	150	3x6 min/1 min	- Official rules of association football, with the exception of the offside rule	Own team centroid Opponent team centroid	5Hz GPS (SPI-PRO, GPSport)	86.67
<i>Beenham et al., (2017b)</i>	40 U-19 players	Compare the external load between SSGs and official matches	2vs2 3vs3 4vs4 10vs10+GK	20x15 25x18 30x20 not revealed	75 75 75 not revealed	4x2 min/3 min 4x3 min/3 min 4x4 min/3 min 1x90 min	- Official rules of association football, with the exception of the offside rule. In the SSGs the aim was to keep the possession of the ball.	Player load (AU)	5Hz GPS (Minimax X3, Catapult)	80.00

^aTotal pitch area divided by total number of players; GK – Goalkeeper; F_{off}- floater of the field; F_{in}-Floater in the field; ^bDimension of the goals -No identified goalkeepers were used; ^cGoalkeepers included; ^deach small sided game were performed with scoring zone, and with a goal; ^eThe recovery between 5th and 6th bout was 15 min; ^f No information about min rest; ^Geach SSG were played in a situation with and without goalkeeper

Table 2. Studies that compared SSGs demands at different (young) ages

Study	Sample	Aim	SSGs Format	Pitch Dimensions (m)	Area per players ^a (m ²)	Training prescription	Rules	Analysed variables	Instrument for analysis	Quality Score (%) (including NA)	Quality Score (%) (excluding NA)
<i>Almeida et al. (2016)</i>	8 U-13 and 8 U-15 Portuguese soccer Players	- Examine the scoring mode (line goal, double goal or central goal) and age-related effects on the defensive performance of youth soccer players during 4vs4 small-sided games.	4vs4	30x20 (line goal, 1x20m)	75	6 sessions in two weeks. In each session, participants performed the three SSGs during 10-min periods interspersed with 5 min of passive recovery.	- The scoring mode was manipulated in two conditions: i) line goal, scoring by dribbling past an extended line; ii) double goal, scoring in either of two lateral goals	Defensive performance: interception, tackle, set play, turnover won, ball recovery sector, configuration of play, defence state.	-Digital video camera; -Match Vision Studio Premium v.1.0	87.50	93.33
			4vs4	30x20 double goal (1x1.5m)	75						
			4vs4	30x20 Central goal (1x3m)	75						
<i>Folgado et al. (2014)</i>	9 U-9, 10 U-11, 10- U13 Portuguese soccer Players	- Identify how tactical collective behaviour varies with age in different small-sided game formats	3vs3 +GK	30x20	75	Each age group played two SSG formats, with 8min duration each and a recovery period of 6min between them.	- No information available	- Collective behaviour as measured by players' field position ratio (lpwratio) and teams centroid distances.	-Digital video camera; - Specific observational instrument tool	81.25	86.67
			3vs3 +GK	30x20	60						
<i>Barnabe et al. (2016)</i>	12 U-16, 12 U-17, 12- U19 Portuguese soccer Players	- Examine whether offensive and defensive collective behaviours emerging in six-a-side football games (GK+5 vs. 5+GK) varied according to age-related practice experience of young, male players	5vs5 +GK	33x60	165	The three groups of participants completed three independent Sessions (8min duration) separated by one-week intervals.	- Official rules of association football were implemented in the games, with the exception of the offside rule. -Goalkeepers were limited to two-touch play with their feet.	- Team dispersion measures (surface area, stretch index, length and width of a team). - Sample entropy and cross-sample entropy measures were used to assess the regularity and synchronization of participant actions in teams.	-GPS (15HZ) devices	75.00	80.00
<i>Olthof et al. (2015)</i>	23 U-17, 16-U19 Netherland	- Determine teams' tactical behavior during small-sided games in two age categories	4vs4 +GK	40x30 Central Goal		Every sub category played six small-sided	- Players and coaches were instructed to win the game.	Intra-team distance (longitudinal and	- Local position measurement (LPM) system	75.00	80.00

soccer Players	(7.32 2.44 m)	games (6 min duration)	<ul style="list-style-type: none"> - Goalkeepers were restricted to two-touch play. - The offside rule was not applied. - Coaches were instructed to encourage and coach their teams similar to competitive match situations. 	lateral); Stretch Index (Longitudinal, lateral). Lpwratio
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Table 3. Studies that investigated Small Sided Games in senior players

Study	Sample	Aim	SSGs Format	Pitch Dimensions (m)	Area per players ^a (m ²)	Training prescription	Rules	Analysed variables	Instrument for analysis	Quality Score (%)
<i>Little and Williams, (2007)</i>	28 elite players	Monitor training intensity during SSGs	2vs2	30x20	150	4x2 min/2 min	- Official rules of association football, with the exception of the offside rule.	RPE Heart rate (%HRmax)	Borg 15-point RPE HR monitor (Polar)	86.67
			3vs3	43x25	~179	4x3.30 min/1.30 min				
			4vs4	40x30	150	4x4 min/2 min				
			5vs5	45x30	135	4x6 min/1.30 min				
			6vs6	50x30	125	3x8 min/1.30 min				
<i>Rampini et al., (2007)</i>	20 amateur players	Analyze the effects of formats, field dimensions and coach encouragement on the intensity of SSGs	3vs3	12x20, 15x25 and 18x30	40,~63 and 90	3x4 min/3 min	- Official rules of association football, with the exception of the offside rule.	Heart rate (%HRmax) Blood Lactate (mmol/L) RPE (CR-10 scale)	HR monitor (S710) LactatePro CR-10 Borg scale	86.67
			4vs4	16x24, 20x30 and 24x36	48,75 and 108					
			5vs5	20x28, 25x35 and 30x42	56,~88 and 126					
			6vs6	24x32, 30x40 and 36x48	64,100 and 144					
<i>Dellal et al. (2008)</i>	10 elite players	Compare heart rate responses within and between SSGs and short-duration intermittent running	1vs1	10x10	50	4x1.30 min/1.30min	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (%HRres)	HR monitors (Polar S-810)	86.67
			2vs2	20x20	10	6x2.30 min/2.30 min				
			4vs4+GK	30x25	~94					
			8vs8+GK	60x45	~169	2x4 min/ 3min				
			8vs.8	60x45	~169	2x10 min/5 min				
<i>Dellal et al. (2011)</i>	20 elite players	Analyze the influence of number of ball touches authorized per possession on physical demands, technical performance and physiological responses	10vs.10+GK	90x45	~203	4x4 min/ 3 min	- Official rules of association football, with the exception of the offside rule.	RPE (CR-10 scale) Blood lactate (mmol/L ⁻¹) Heart rate (%HRmax, %HRres) Number of duels Percentage of successful passes Number of ball losses Total number of ball possessions Total distance (m) Total distance in sprint (m)	RPE (CR-10 scale) Lactate Pro HR monitor (Polar S-810) Hand notational system Portable GPS (GPSports)	86.67
			Three task conditions: playing at 1 touch, 2 touches and free play	30x20	75					

<i>Dellal, Chamari, et al. (2011)</i>	20 elite players	Analyze the effects of changes in the number of ball touches on the physiological, technical and physical demands	2vs2 3vs3 4vs4 Three task conditions: playing at 1 touch, 2 touches and free play	20x15 25x18 30x20	75 75 75	4x2 min/3 min 4x3 min/3 min 4x4 min/3 min	- Official rules of association football, with the exception of the offside rule.	RPE (CR-10 scale) Blood lactate (mmol/L ⁻¹) Heart rate (%HRmax, %HRres) Number of duels Percentage of successful passes Number of ball losses Total number of ball possessions Total distance (m) Total distance in sprint (m)	RPE (CR-10 scale) Lactate Pro HR monitor (Polar S-810) Hand notational system Portable GPS (GPSports)	86.67
<i>Dellal, Hill-Haas, et al. (2011)</i>	20 elite players	Analyze the relationship between playing level and the physiological impact, perceptual responses, time-motion characteristics and technical activities during various SSGs	2vs2 3vs3 4vs4 Three task conditions: playing at 1 touch, 2 touches and free play	20x15 25x18 30x20	75 75 75	4x2 min/3 min 4x3 min/3 min 4x4 min/3 min	- Official rules of association football, with the exception of the offside rule.	RPE (CR-10 scale) Blood lactate (mmol/L ⁻¹) Heart rate (%HRmax, %HRres) Number of duels Percentage of successful passes Number of ball losses Total number of ball possessions Total distance (m) Total distance in sprint (m)	RPE (CR-10 scale) Lactate Pro HR monitor (Polar S-810) Hand notational system Portable GPS (GPSports)	86.67
<i>Fanchini et al., (2011)</i>	19 amateur and professional players	Analyze the effects of SSGs bout duration on the intensity and technical actions	3vs3+GK	37x31	191	3x2 min/ 4min 3x4 min/4 min 3x6 min/4 min	2 touches maximum and coach encouragement. Official rules of association football, with the exception of the offside rule.	Heart rate (%HRmax) RPE (CR-10 scale) Technical actions (pass, successful pass, unsuccessful pass, tackle, header, turn, interception, dribbling, shoot and shoot on target)	HR monitor (Suunto t6 Team Pack Pro) CR-10 Borg scale Notational system and a digital video camcorder	86.67
<i>Gomez-Piriz et al. (2011)</i>	22 professional players	Quantify the validity of total body load and its relationship with RPE and analyze differences of total body load and RPE between playing positions in different SSGs	5vs5 6vs6 7vs7 8vs8	52.5x34 80x68	-	4x4 min/2 min	With coach encouragement. Official rules of association football, with the exception of the offside rule.	Total body load (AU) Session-RPE (min)	1 Hz GPS (GPSports systems) RPE	86.67
<i>Owen et al. (2011)</i>	15 professional players	Analyze the variance of heart rate responses and technical actions between two sided games	3vs3+GK 9vs9+GK	30x25 60x50	125 166.6	3x5 min/4 min	- Official rules of association football, with the exception of the offside rule.	Heart rate (%HRmax) Technical performance (block, dribble, header, interception, pass,	HR monitor (Polar Team System) Notational system and	86.67

									receive, shot, turn, tackle, total ball contacts per game and ball contacts per individual)	videorecording	
Casamic hana et al. (2012)	27 semiprofessional players	Compare the physical demands of friendly matches and SSGs	3vs3 5vs5 7vs7 11vs11	Ratio of 1.45:1	210	3x4 min/2 min Official match duration in 11vs11	Official rules of association football, with the exception of the offside rule in the case os SSGs.	Distance covered (m/min) Distance covered (m/h) Percentage of time in each speed zone (%T) Player workload	10Hz GPS (MinimaxX version 4.0)	86.67	
Dellal, Owen, et al. (2012)	40 elite players	Compare the physical demands of SSGs (with task conditions) and 11vs11 matches	4vs4* 11vs11 *Four supporting players with instructions to keep the possession of the ball	30x20 100x60	75 ~273	4x4 min/3 min 90 min	Official rules of association football, with the exception of the offside rule in the case os SSGs.	Blood lactate (mmol/L) RPE (10 point scale) Heart rate (%HRmax and %HRres) Total distance (m) Sprinting distance (m) High intensity running distance (m) Number of duels % of successful passes Total number of balls lost Total number of ball possession	Lactate Pro RPE (10-point scale Foster) HR monitor (Polar Team Sport System) 5Hz GPS (GPSport SPI Elite System) Semi-automatic multiple camera systems (Amisco Pro) Notational system using video recording	86.67	
Dellal, Varliette , et al. (2012)	22 amateur players	Compare the effects of SSGs and high intensity intermittent training on aerobic and intermittent test with changes of direction	1vs1 2vs2	15x10 20x20	75 100	5x1.30 min/1.30 min 5x2.30/2 min	- Official rules of association football, with the exception of the offside rule.	Heart rate (HRmax and HRres) RPE (CR-10 scale)	HR monitor (Polar RS800) RPE (CR-10 Borg scale)	86.67	
Castella no et al. (2013)	14 semi-professional players	Analyze the influence of playing format and number of players in the physiological and physical demands	3vs3 5vs5 7vs7 Three task conditions: collective possession of ball, with goalkeepers, with small goals and no goalkeepers	43x30 55x38 64x46	210 210 210	3x6 min/5 min	- Official rules of association football, with the exception of the offside rule.	Heart rate (HRmean, %HRmax) Distance covered (m) Player load (UA) Work:rest ratio (AU)	HR monitor (Polar Team Sport System) 10Hz GPS (MinimaxX version 4.0)	86.67	
Frencke n et al., (2013)	10 amateur players	Evaluate the effect of different pitch dimensions on tactical behavior	4vs4+GK	24x16 24x20 30x16 30x20	48 60 60 75	4x8 min/8 min	- Official rules of association football, with the exception of the offside rule.	Centroid position Surface area	100 Hz Local Position Measurement (LPM)	93.33	

<i>San Román-Quintana et al. (2013)</i>	14 amateur players	Analyze the effects of limiting the ball touches in physiological responses and physical demands	7vs7+GK Played with 1-touch, 2-touches and free	60x49	245	12 min	- Official rules of association football, with the exception of the offside rule.	Heart rate (mean, %HRmax) Distances at different speeds Maximal speed	Polar Team Sport System 10Hz GPS (MinimaxX, v4.0., Catapult)	80.00
<i>Casamic hana et al. (2013)</i>	10 amateur players	Examine the physical and physiological impact of different training regimens	5vs5	55x38	210	4x4 min/ 1min 2x8 min/ 2min 1x16 min	- Official rules of association football, with the exception of the offside rule and scoring method	Distances at different speeds Player load Heart rate (mean, %HRmax)	10Hz GPS (MinimaxX, v4.0.) 100Hz Accelerometer HR monitor (Polar Team Sport System)	80.00
<i>Beato, et al. (2014)</i>	12 amateur players	Analyze the effect of high volume of SSGs on physiological, perceptual responses and technical actions	3vs3 4vs4	30x20 30x20	100 75	6x4 min/2 min	- Official rules of association football, with the exception of the offside rule.	Heart rate (mean; %HRmax) RPE (CR100 scale) Technical actions (passes, target passes, shots, dribbling, interceptions and tackles)	HR monitor (RS400D) Borg CR100 scale Hand notation system with a video-recording	93.33
<i>Clement et al. (2014)</i>	10 amateur players	Analyze the effects of different SSGs on HR, technical performance and time-motion	2v2+2 3v3+2 4v4+2 formats were played at three different tasks conditions: T1 (scoring by crossing the endline); T2 (scoring by crossing two small targets); and T3 (scoring by crossing a small central target)	19x19 23x23 27x27	~90 ~90 ~90	3x5min/3 min 3x5 min/3 min 3x5 min/3 min	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (mean and %HRres) Distance (km) Speed (m/s) Volume of play Attacks with ball Efficiency index Performance score	HR monitor with GPS (Polar RC3 GPS) and Team Sport Assessment Procedure (TSAP)	93.33
<i>Casamic hana et al. (2014)</i>	12 semi-professional players	Analyze the effect of exercise duration and the number of touches allowed during possession on time-motion characteristics and physiological responses	6vs6	60x49	245	12 min (split by 2 periods without resting time)	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (HRmax zones) Distance covered (m) Player load (UA) Work:rest ratio (AU) Accelerations (m/s)	HR monitor (Polar Team Sport System) 10Hz GPS (MinimaxX version 4.0)	86.67
<i>Gaudino, Alberti, et al. (2014)</i>	26 elite players	Analyzed the influence of game format and number of players on the physical demands	5vs5 7vs7 10vs10 The three formats were played with two task conditions: possession play only	30x30 27x27 45x35 37x37 66x45 52x52	75 73 98 98 135 135	4 min	Maximum of 2 touches allowed. Offside rule was not applied during the SSGs	Total distance Total high-speed running High speed Very high speed Maximal speed Changes in velocity Number of moderate accelerations	15 Hz GPSports, SPI-pro X	93.33

			and game with goalkeepers and regular goals						Number of high accelerations Number of moderate decelerations Number of high decelerations Energy cost Metabolic power Total high power High power Elevated power Maximal power		
<i>Gaudino , Iaia, et al. (2014)</i>	26 elite players	Evaluate the association between high-intensity activity in SSGs based on running speed and estimated metabolic power and evaluate bias between 2 approaches is dependent upon playing position or drill characteristics	5vs5 7vs7 10vs10	30x30 45x35 66x45	75 98 135	5 min 8 min 14 min	Official rules of association football, with the exception of the offside rule and scoring method	Total distance Total high speed Total high power	15 Hz GPSports, SPI-pro X	86.67	
<i>Travasso s et al. (2014)</i>	20 professiona l players	Quantify how change on targets information modifies team's tactical behavior	5vs5 Played at two conditions: goalkeeper in regular goals and with 3 small goals per team	30x25	75	5 min/3 min	Official rules of association football, with the exception of the offside rule and scoring method	Total time played in each pitch zone Centers of gravity Stretch index Relative stretch index	15 Hz GPSports, SPI-pro	86.67	
<i>Owen et al. (2014)</i>	16 elite players	Compare the technical activity and physical movements of various-sided games	4vs4 5vs5 6vs6 7vs7 8vs8 9vs9 10vs10 11vs11	30x25 46x40 50x44 54x45 60x50 70x56 80x70 100x74	94 184 183 174 188 218 280 336	3x5 min/3 min	Official rules of association football, with the exception of the offside rule and scoring method	Distance at different speeds (stationary/walking, jogging, running, high-speed running and sprinting) Notational analysis (block, dribble, header, interception, pass, receive, shot, turn and tackle)	5Hz GPS (MinimaxX, Catapult) Hand notation system and videorecordin g	86.67	
<i>Hodgson et al. (2014)</i>	8 collegiate players	Quantify the time-motion characteristics and technical actions between different pitch dimensions	4vs4+GK	20x30 40x30 50x40	75 150 250	4x4 min/3 min	Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (%HRmax) Total distance High speed distance Accelerations Decelerations Technical actions (pass, turn, dribble, shot, tackle, header and interception)	HR monitor (Polar RS400) 10Hz GPS (MinimaxX, Catapult) Hand notation system and videorecordin g	86.67	
<i>Clement e, e al. (2015)</i>	10 amateur players	Analyze the effect of being floater on heart rate responses and speed	1v1+2 2v2+2 3v3+2 4v4+2	16x11 19x19 23x23 27x27	~90 ~90 ~90 ~90	3x2 min/2 min 3x3min/3 min 3x4 min/4 min 3x5 min/5 min	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (mean and %HRres) Speed (m/s)	HR monitor with GPS (Polar RC3 GPS)	93.33	

			formats were played at three different tasks conditions: T1 (scoring by crossing the endline); T2 (scoring by crossing two small targets); and T3 (scoring by crossing a small central target)							
<i>Torres-Ronda et al. (2015)</i>	22 elite players	Analyze the effects of unbalance SSGs in internal and external load	4vs3+GK 4vs5+GK 4vs7+GK	40x30	~171 ~133 ~109	2x3 min/4 min	- Official rules of association football, with the exception of the offside rule	Body load Distance covered Exertion index Heart rate (TRIMPmod) RPE (CR-10 scale)	5Hz GPS (SPI-ProX, GPSports) HR monitor (Polar Team Sports System) RPE (CR-10 Borg scale)	86.67
<i>Casamic hana et al., (2015)</i>	18 amateur players	Analyze the effect of type of marking and the number of players on the physical and physiological demands	3vs3 6vs6 9vs9 Played in the conditions of man-to-man marking and free-play	19x29 40x28 55x30	~92 ~92 ~92	6 min	- Official rules of association football, with the exception of the offside rule and scoring method (keep the possession of the ball)	Heart Rate (mean and %HRmax) Player load (AU) Maximal speed (km/h) Distances at different speeds	HR monitor (Polar Team Sport System) 10Hz GPS (MinimaxX, v4.0., Catapult)	80.00
<i>Clement e, et al. (2016)</i>	10 amateur players	Analyze the effects of using or not using floaters on HR responses and distance	1x1 1x1+1 - formats were played at three different tasks conditions: T1 (maximize the possession of the goal without scoring goal); T2 (scoring by crossing the opponent's endline); and T3 (scoring in a small central goal)	15x10 15x10	75 75	3x3 min/3 min	- Official rules of association football, with the exception of the offside rule and scoring method	Heart rate (%HRres) Distance (km)	HR monitor with GPS (Polar RC3 GPS)	93.33
<i>Goncalv es et al.(2016)</i>	22 elite players	Compare the player's positioning dynamics when manipulating the number of opponents and teammates in SSGs	4vs3+GK 4vs5+GK 4vs7+GK	40x30	~171 ~133 ~109	3 min/4 min	- Official rules of association football, with the exception of the offside rule	Distance to centroid Distance to opponent centroid Distance to nearest opponent Effective playing space	5Hz GPS (SPI-ProX, GPSports)	86.67

<i>Güven et al. (2016)</i>	8 amateur players	Determine the effects of different pitch sizes on technical actions during SSGs	4vs4	34x26 40x30	~111 150	3x6 min/5 min	- Official rules of association football, with the exception of the offside rule	Technical actions (shot, pass number, accurate pass, inaccurate pass, dribbling, interception, tackle and ball possession)	Computer notation technique	86.67
<i>Jastrzębski et al. (2016)</i>	13 professional players	Compare the physiological response and time-motion analysis of male and female players during 4vs.4 SSGs	4vs.4	40x30	120	4x4 min/2 min	- Official rules of association football, with the exception of the offside rule. Coaches encouragement.	Distance covered at different speeds (standing+walking, jogging, running, high-speed running, sprint and total distance) Heart rate (%HRmax)	10Hz GPS (MinimaxX version 4.0) HR monitor (Polar Team Sport System)	86.67
<i>McLean et al. (2016)</i>	12 semi-professional players	Compare the effects of different resting periods between SSGs bouts on technical actions	3vs3	15x20	50	6x2 min/30 sec 6x2 min/120 sec	The goal of the SSG was to keep the possession of the ball. Official rules of association football, with the exception of the offside rule and scoring method.	Technical actions (time in possession, touches in possession, successful passes, intercept, deflection, successful and unsuccessful 1 st touche pass, success and unsuccessful tackles, lost possession, technical actions per minute and time ball is out of play)	Notational system and videorecording	93.33
<i>Ric et al. (2016)</i>	8 professional players	Identify the dynamics of tactical behavior emerging on SSGs	4vs3+GK 4vs5+GK 4vs7+GK	40x30	~171 ~133 ~109	3 min/4 min	- Official rules of association football, with the exception of the offside rule	Movement speeds (stand, walk, jog, medium-intensity running, high-intensity running and sprint) Tactical actions Inter-player contexts Pitch zones	15 Hz GPS (SPI ProX, GPSport) Videorecording and Lince software	93.33
<i>Stevens et al. (2016)</i>	141 professional and amateur players	Compare 6vs6 format between different fitness levels and analyze the association between 6vs6 performance and aerobic capacity	6vs6+GK	40x34	~113	4x7 min/2 min	Official rules of association football, with the exception of the offside rule. Coaches used encouragement.	Total distance Estimated metabolic power High speed High acceleration High power Very high power Heart rate (mean) RPE (CR-10 scale)	24Hz Local Position Measurement (LPM) HR monitor (Polar wearlink) RPE (CR-10 Foster scale)	86.67
<i>Clement et al. (2017)</i>	6 collegiate players	Analyze the influence of SSGs bouts on HR, RPE,	1vs1 3vs3	15x10 19x24	75 75	3x2 min/3 min 3x3 min/4.3 min	- Official rules of association football, with the exception of	Heart rate (mean and %HRmax) Total distance (m)	Polar H7 Bluetooth	93.33

		external load and lower limb power					the offside rule. Scoring in small goals of 2 m.	Walking distance (m) Jogging distance (m) Running distance (m) Sprint distance (m) Player load (volume) Number of sprints (n) Max speed (km/h) Pace (m/min) Player load intensity (g/min) RPE (CR-10 scale) Jump height (cm)	10-Hz GPS (Johan Sports) CR-10 RPE scale Contact platform (Chronojump – Boscosystem)	
<i>Lacome et al. (2017)</i>	21 elite players	Compare the peak intensity of typical SSGs with official matches	4vs4+GK 6vs6+GK 8vs8+GK 10vs10+GK	25x30 30x40 40x40 102x67	71 87 106 311	6x3 min/90 sec 4x4 min/2 min 2x10 min/3 min 1x30 min/0 min	- Official rules of association football, with the exception of the offside rule.	Total distance High speed running Mechanical load	15Hz GPS (SPI-Pro, GPSport)	93.33
<i>Ferraz et al. (2017)</i>	20 semi-professional players	Identify the influence of prior knowledge of exercise duration on players' pacing patterns	Not specified	20x40	Not specified	20 min	- Official rules of association football, with the exception of the offside rule	RPE Total distance Ratio high/very high running Ratio moderate running Ratio low running Game pace Total body impacts	Borg 6-20 scale 5Hz GPS (SPI ProX II)	80.00

FIGURE LEGENDS:

Figure 1. Preferred reporting items for systematic reviews flow diagram

Figure 2. Scopes of Small Sided Games